XXVII.—*On the Conario-hypophysial Cerebral Tract of Professor Owen.* By Robert Garner, F.R.C.S., F.L.S.

A remarkable paper on this subject was read by the veteran anatomist above named at the meeting of the British Association in 1881, and published in full in the Journal of the Linnean Society for January of this year, throwing light on those enigmatical parts of the brain, the hypophysis or pituitary gland, and the pineal gland, together with the intervening third ventricle. The Professor also draws other conclusions, to be alluded to further on in this paper.

He alludes to Dr. Sapolini's ideas respecting the glandular nature of the pituitary, which are, perhaps, but a version, further carried out, of views which have been held by many anatomists—that the parts in question are an essential to the secreting and serous system of the brain, indicated, in fact, by the old name of glands. But passing by other notions which have been, or might be, held on this subject—that the bodies and region in question have some topographical relations to the formation of the cerebral convolutions (Foville and Callender), that the so-called glands may indicate respectively the junction of the cerebral and spinal tracts, the pituitary being situated at the termination of the motor, and the pineal at the termination of the sensitive spinal tract, or that they act as sensitive nerves, indicative of the state of the brain or its bony case—the Professor enunciates his own theory, a deduction from certain not unknown facts, but especially from others more modern of an embryological nature, which theory appears to us to be made out and quite his own.

If we descend from fishes, as the skate, dogfish, or cod, to the cephalopodous mollusk, say the sepia, it will be evident that in the latter the nervous system is concentrated into what may be termed a brain (fig. 1, p. 284), corresponding, generally speaking, to the brain of the fish, but that it is threaded, as it were, by the œsophagus, this tube having a course which, in the fish, would be from the pituitary through the third ventricle and out at the pineal, or *vice versâ*.

Passing over, as already observed, all supposed uses or functions of the parts composing this tract in the vertebrates, they are considered to be the altered homologues of the œsophagus and mouth, as seen in the sepia. The reasoning from which these conclusions were drawn are, as just said, founded on certain embryological facts—*imprimis*, that though the intestinal canal of the invertebrates answers, upon the whole, to that of the vertebrates, the anterior inlets of the two do not

correspond, the mouth of the invertebrate being a *deutostome* and temporary one in the embryo vertebrate (the entry of the umbilical vessels forming the primary *protostome*), whilst the mouth of the vertebrate is the final *tritostome*. We are not informed, however, in what vertebrate embryo such an anterior communication through the palate is actually found; but the inference is that way, and the presumption strong. In some reptiles the place of the pineal must be looked for immediately under the pericranium, at the so-called parietal foramen. An approach to such a course of the œsophagus is figured in the embryo lamprey, after W. B. Scott; and there is the close connexion of the pituitary with the gastro-branchial or gastro-pulmonary inlet (and he avails himself of Mr. Balfour's labours on this embryological point) in Elasmo-branch fishes. Indeed such a connexion almost remains in some birds, as in the cuckoo or goose, in the last of which the pituitary descends backwards half an inch in the sphenoid, and the canal communicates by two small openings with the lower surface of the skull.

So far, then, the argument is, that the neural mouth in the invertebrate is a temporary one or embryonic in the vertebrate, and that the mouth and the œsophagus of the invertebrate become the conario-pituitary tract of the vertebrate. This theory seemingly makes plain the unity of organization and composition between the two great divisions of animals, and also seems to bridge over a hiatus which has always been perplexing to the naturalist.

The Professor, however, extends his conclusions further. We may see from his theory of the typical vertebra, from other views in the 'Comparative Anatomy of Vertebrates,' as well as from the present paper, that he by no means lags behind in many of the philosophical theories first proposed by Goethe and Oken, and especially advocated in France previous to 1830* by Geoffroy St.-Hilaire, Blainville, &c., but opposed strongly by Cuvier. Geoffroy took up certain views of two young anatomists, that there is perfect *unity of plan* between the highest mollusk (*Sepia*) and the vertebrate (a bird). All that is required to make the matter plain is, according to this, to bend the spinal column of the latter back upon itself, after the fashion of an acrobat, when a position is obtained apparently similar to the form of the sepia. Cuvier combats all this; and his paper was published in the 'Annales

* The writer attended Blainville's *leçons* in the year 1830 at the Jardin, and with an introduction also to Cuvier himself. Most would admit that the transcendental views alluded to ran somewhat wild at this time, though many of them have been adopted since.

des Sciences Naturelles,' with two diagrams, a little more comprehensive than those given by the English anatomist, and, we think, not quite pliable to the views assumed by Geoffroy. Cuvier's views are principally founded on the difference of the relations of the œsophagus to what he considers the brain (upper ganglion) in the sepia; but Prof. Owen's theory, in the main, certainly does away with Cuvier's principal objection.

Cuvier insists on the strict limitation of terms; there is much *similarity* but not *identity* of structure, and of composition by similar parts and organs; but as to the *unity of plan* there is little or none, any more than that a cottage is built on the same plan as a many-storied mansion. He seems averse to have recourse to type and uniformity, but brings forward adaptive variation or relation to the exterior under the name of *conditions of existence*.

The first and simple conclusion of Owen, so far made good we think, is a very remarkable homological deduction. The mouth and gullet of the invertebrate becomes a cerebral tract of the vertebrate, with uses as a component of the cerebral spinal system; or rather, if I may suggest, the invertebrate œsophagus with its attached glands alone becomes the tract in question; whilst the large buccal mass of the sepia, being dermal in its origin, is but transposed in the vertebrate. The peculiar loop-like character of the brains of some cartilaginous fishes is owing to the patency of the tract.

When we follow up the subject, though we think it may be said that there is much similarity in many respects between the sepia and the fish, we, with Cuvier, must doubt whether there is unity of plan. The sepia and all Mollusca are monosomous; no vertebrate is so, though some fishes, as *Lophius* (fig. 2) may approach to this. It is this want of sameness as to plan which is the essential difference; for the sepia has certainly more constituent parts which appear to answer to those of a vertebrate than is generally recognized—the principal nervous divisions and a cartilaginous cranium and traces of the maxillæ, with several scattered cartilaginous elements supporting the trunk, fins, breathing-parts, &c., though the shell continues to be the principal support, analogous to, but not the homologue of, the spinal column.

According to the Professor's ultimate deduction, the change from the invertebrate to the vertebrate is effected by the œsophagus of the latter leaving its lower or posterior cerebral exit and diverging under or behind the cerebral ganglia, and so opening on what must now be considered as the anterior hæmal aspect—that is, on the same side as the shell or *os*

sepiæ is situated. This view answers well enough in making the two portions of the beak of *Sepia* to correspond with the avian beak; and no doubt the spiniferous lamina may equally well be considered as either the tongue or the palate. But it may be objected that, according to this view, the umbilical canal would enter the body on the neural or dorsal aspect, the aural sacs would be wrongly placed, also that the ventral or hæmal surface is more highly coloured, and that the young sepia, when progressing, prefers that surface to be upwards, like the vast majority of invertebrates: here also is lodged the *os sepiæ*, the analogue, though by no means the homologue, of a spine. The great nervous tracts of the mantle too, though they arise from the subœsophageal ganglia, are directed towards this aspect; and if any tracts must be considered as spinal, these, through all the Mollusca, seem to correspond, though the primitive annular disposition of a ring or loop remains.

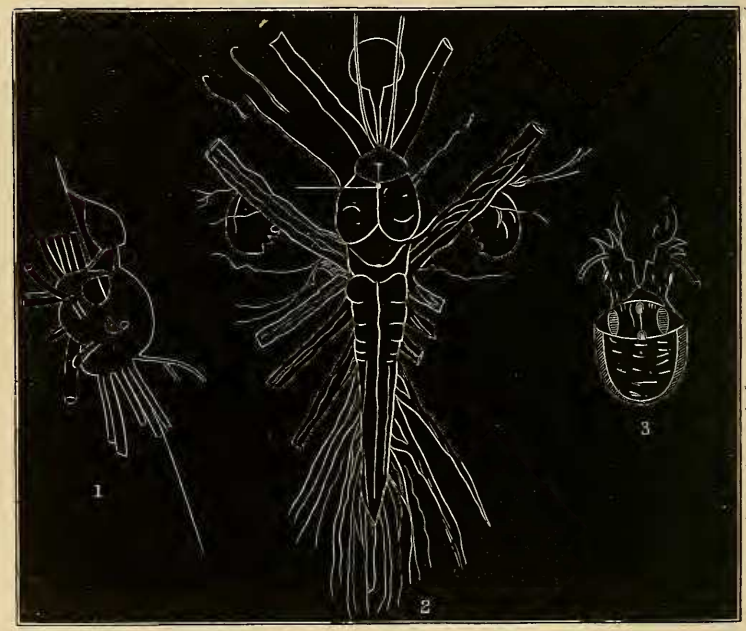
The situation of the ganglia in the invertebrate is determined by that of the locomotive, prehensile, and respiratory organs, the only type of formation recognizable. Thus the helix, with its foot homologous to that of the sepia, though entirely postoral and undivided, has its lower parts much as in *Sepia*; in *Aplysia*, having lateral processes of the body, the ganglia in question are lateral; and in *Doris*, with its strong mantle above and weak foot below, all the ganglia of the ring form one mass on its upper part, it being only completed by a commissure. Other objections to the theory that by *reversing surfaces and change of nomenclature* the sepia becomes tantamount to a bird, are that the relative position of the liver and alimentary canal do not seem to correspond, and the situation of the main artery would also be ventral, whilst the vein would be on the opposite aspect. Certainly the heart and the respiratory organs, which in the sepia may, according to the old nomenclature, be said to be ventral, are in many lower mollusks dorsal; but this has no relation to the question, but is due rather to what Cuvier terms the conditions of existence*.

Admitting the originality and truth of the Professor's main view, is it certain that the transfer of the oral opening has

* We have elsewhere (Ann. & Mag. Nat. Hist., May 1877) endeavoured to explain the different situations of the shell and its relative development in the sepia, nautilus, argonaut, and in Gastropods. In the first the cellular part (*vulgo* bone) is only partially present and is dorsal; in the second and third the expanded part is present on the ventral side; whilst in the snail or whelk its expansion (as well as the branchiæ) is dorsal; but this is from the torsion of this part of the body, and the ascension, as it were, of the branchiæ and the nerves, &c.

been in the direction and in the mode indicated? If so, certainly a very easy way is discovered of solving a difficulty; the morphology of a caterpillar agrees with that of the vertebrate; and we are compelled to admit that a snail or a worm in reality creeps on its back, that the convex part of a lobster is on the ventral aspect, with its limbs reversed in their direction to those of the vertebrates, &c.

But another explanation, which still requires the Professor's view of the conario-hypophysial tract and that the supra-œsophageal ganglion answers to the fore brain, yet implies the correctness of the old opinion as to the upper and lower surface in the sepia, appears to answer all requirements, embryological, anatomical, and otherwise. The accompanying sketch may be thought to be what the French call a *vue schématique*; but it is true to nature (fig. 1).



The subœsophageal ganglion in the invertebrate, *projected forwards* to correspond to the exterior or *condition of existence*, is composed of three constituents, marked out by the passage of the aorta:—the anterior one at the base of those prehensile and partly locomotive organs the feet or arms; in the middle the part supplying the external orifices of respiration (that is,

the funnel and nuchal valves), which are in some species also connected with locomotion, from their effect when in action, also the organ of hearing; and most posterior another portion, from which are derived visceral, branchial, and those large compound nerves given to the mantle. We may very fairly point out olfactory, optic, and auditory nerves, in their proper situation, oculo-motor, the fifth or tentacular (the pes anserinus of Cuvier), the seventh or siphonic, the vagus or great visceral nerve, and the pair of nerves which go backwards to the mantle and its muscles, and have been considered analogous to the spinal cord. The view advocated only trenches upon that of our *Chef* in this, that the supposed *quondam* entry and exit of the œsophagus through the brain are reversed. Both views seem strange enough; one must be true; and we think this is less strange than the other. The new mouth appears to enter, in the vertebrate, on what corresponds to the siphonic or lower side—that is, apparently, where the yolk (in the sepia) is absorbed in the crop (protostome, see fig. 3); the mouth of the matured sepia has relation to the pituitary rather than to the pineal, and the exit of the œsophagus, *vice versâ*, to the pineal rather than to the pituitary. Perhaps the inferior hypoaria ganglia of fishes may be explained as remnants of the molluscan arrangement; but let that go.

We are inclined, then, to believe that *morphological fitness* or *conditions of existence* must be considered as well as *typical formation*, the former often overriding the latter; and whilst we concur in the terms *neural* and *hæmal* in anatomy, the common terms *dorsal* and *ventral*, or others more anatomically correct (say *upper* and *lower*), we think must be retained, though the two sets of terms are distinct.

Admitting the truth and originality of Prof. Owen's main proposition, it perhaps may still be held that less is required to believe, with Cuvier, that the subœsophageal nervous ganglia in the Mollusca, which appear homologous with the medulla oblongata of the vertebrate, and so of the ventral cords of Articulata, which may be the homologue of the medulla spinalis, really occupy the ventral aspect of the body, than to adopt a view which ignores many other conditions and morphological considerations, and leads to such strong conclusions.